Influence of realistic load profiles on Lithium-Ion Cell Degradation

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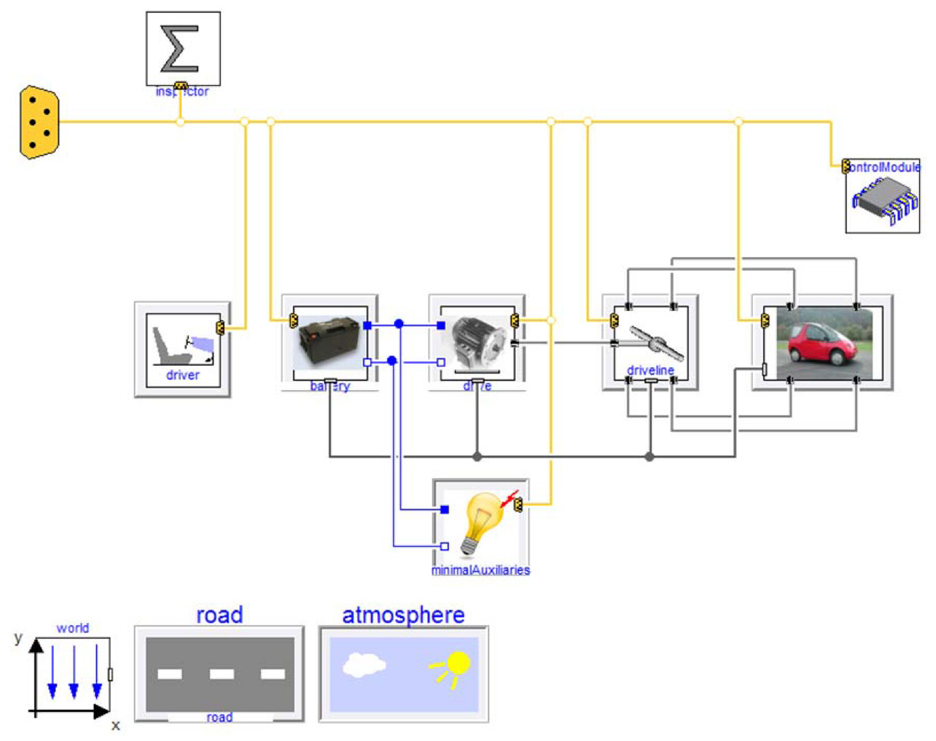
Introduction

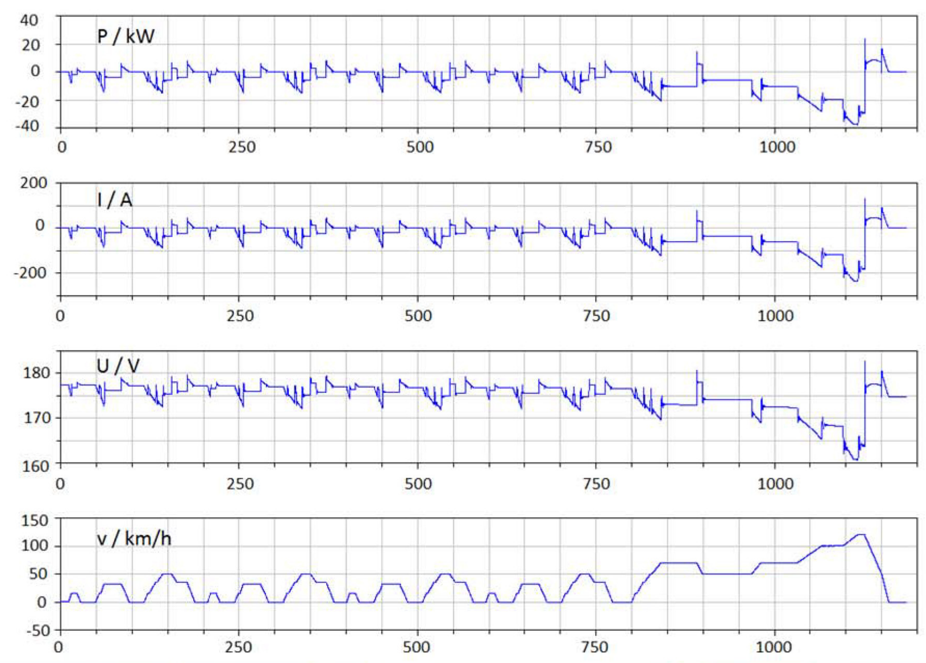
The degradation of batteries is dependent of the use in their particular application. The loss of capacity because of cycling correlates in some degree to utilization in consumer electronic devices. But the utilization in battery electric vehicles (BEV) imply a different strain for the used battery cells. For example a BEV (with recuperation) in urban traffic accelerates and decelerates periodically. This represents a special stress influence due to the alternating load between discharge and charge.

In this study the effects of BEV utilization on lifetime performance of commercial Lithium-Ion cells were investigated. Therefor single cells were stressed in a test bench with different realistic load profiles according to standardized driving cycles. The used data were obtained from a Modelica simulation of the city car Hotzenblitz which is a limited-lot production vehicle.

Model of BEV

The actual vehicle is equipped with a 12kW electric traction drive and reaches a maximum speed of 112km/h. For the simulation an increased traction motor of 30 kW was assumed, so the applied driving cycles could be fulfilled.





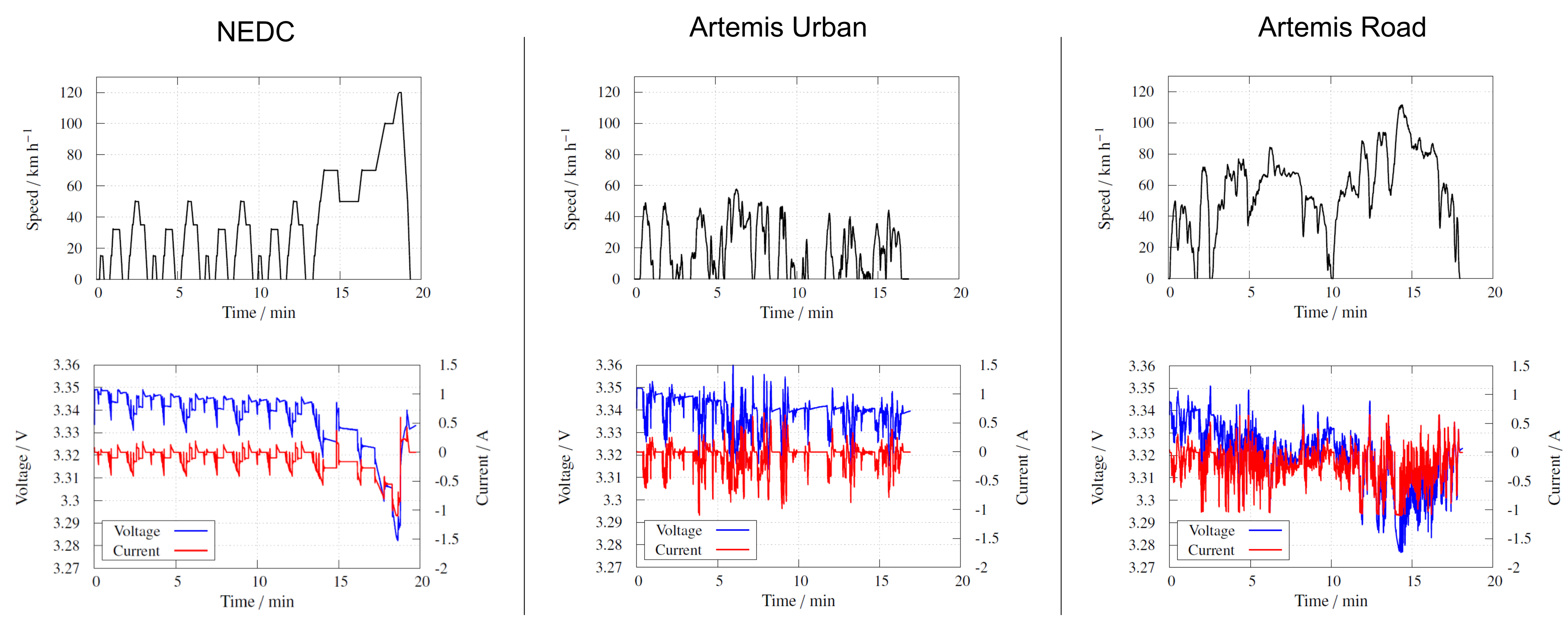
Experimental Results

	NEFZ[1]	Artemis[2] Urban	Artemis[2] Road
Duration	~ 20 min	~ 16.6 min	~ 18 min
Distance	11017 m	9082 m	17275 m
Maximum Speed	120 km/h	60 km/h	110 km/h

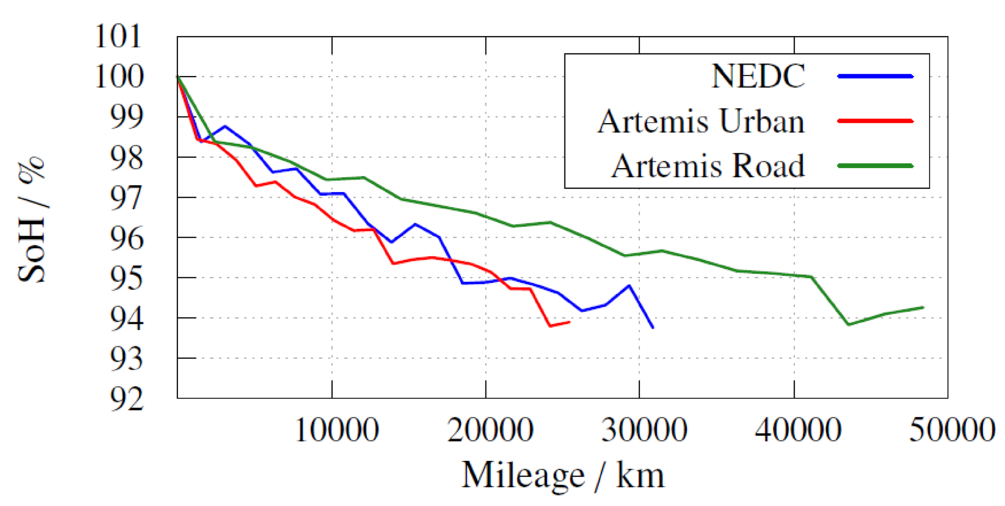
1) New European Driving Cycle
2) Assessment and Reliability of Transport Emission Models and Inventory Systems

High power Lithium Ion Cell
A123 Systems, APR18650M1A, $LiFePO_4$, 1.1Ah

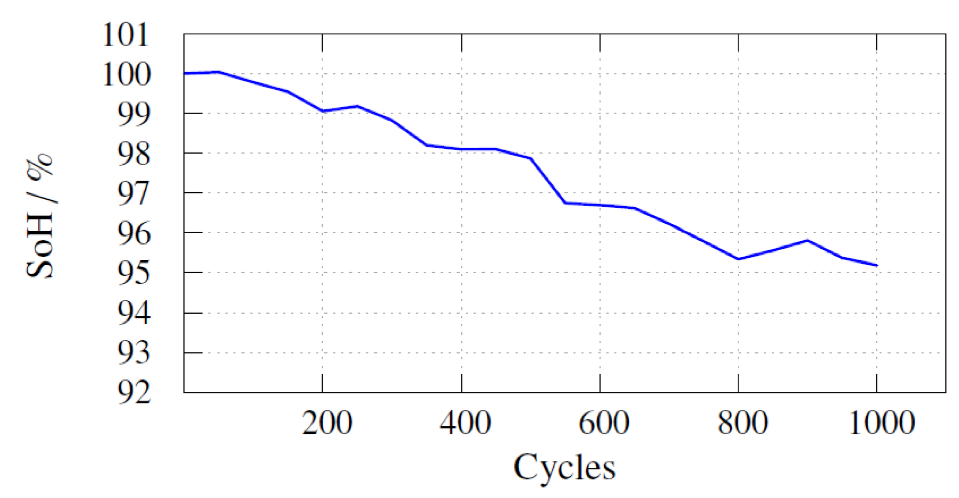
Scaling of Profile: 1C max. discharge



Life Characteristic



Influence of Driving Cycles



Cycle Life, 100% DoD, Room Temperature

Conclusions

Realistic load profiles were transferred from vehicle level to cell level.

The Common Artemis Driving Cycle (CADC) Urban compared with the CADC Road shows a stronger SOH loss.

The NEDC shows a similar life characteristic than the CADC Urban. Although the duration of the NEDC is the longest of the compared driving cycles, the covered distance is in the range of the CADC Urban.

Both indicates that frequent acceleration and deceleration in urban traffic contributes more to the degradation of a battery cell than high kilometric performance in overland traffic.

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